LOUISIANA DEPARTMENT OF WILDLIFE & FISHERIES

OFFICE OF FISHERIES
INLAND FISHERIES SECTION

PART VI -B

WATERBODY MANAGEMENT PLAN SERIES

CADDO LAKE

WATERBODY EVALUATION &
RECOMMENDATIONS 2017

CHRONOLOGY

DOCUMENT SCHEDULED TO BE UPDATED EVERY THREE YEARS

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WATERBODY EVALUATION

STRATEGY STATEMENT

Recreational

Largemouth bass are managed to provide the opportunity to catch fish of greater than average size. Sunfish, catfish and crappie are managed to provide a sustainable population so anglers have the opportunity to catch or harvest numbers of fish.

Caddo Lake lies on the border between Louisiana and Texas. Efforts have been made in recent years to unify and maintain the same recreational regulations on the lake for both states. Moving forward, it is paramount to recognize both states' recreational strategies for the lake in order to maintain unified regulations.

Commercial

Catfish are managed to provide sustainable populations.

Species of Special Concern

No threatened or endangered fish species are found in Caddo Lake. The bluehead shiner (*Pteronotropis hubbsi*) has been found in the watershed basins of Caddo Lake. In 2014, the status changed from data deficient to near threatened for the species. It is threatened by draining, filling, farming and flooding of backwater swamp habitat, and over collection for the aquarium trade.

EXISTING HARVEST REGULATIONS

Recreational

Crappie – 25 daily per person, no size restrictions

Sunfish (Bluegill, Redear, etc.) - no daily limit or size restrictions

Largemouth Bass – 14-18" slot limit – all bass that measure from 14.0 to 18.0 inches must be released immediately – 8 fish daily bag limit in aggregate with spotted bass, of which no more than 4 can be over 18 inches

Spotted Bass – 8 daily per person in aggregate with largemouth bass, no size restrictions

Yellow Bass – no daily limit or size restrictions

White Bass – 25 daily per person, no size restrictions

Flathead Catfish – 10 daily per person, 18-inch minimum length limit

Channel and Blue Catfish – in aggregate, 50 daily per person, with no minimum length limit, but only 5 fish may be over 30 inches

The recreational fishing regulations may be viewed at the link below:
http://www.wlf.louisiana.gov/fishing/regulations

Commercial

Use of gill nets, trammel nets, and fish seines are prohibited on Caddo Lake. The commercial fishing regulations may be viewed at the link below:
http://www.wlf.louisiana.gov/fishing/regulations

SPECIES EVALUATION

Recreational

Caddo Lake has been sampled with various types of gear over the years. Biomass (rotenone) sampling was one of the primary sampling methods utilized from 1954 through 1991 in an effort to estimate standing crop of all fish in the lake. Biomass sampling was discontinued in 1991 and electrofishing samples were initiated to collect information specifically on largemouth bass and crappie populations. Largemouth bass and crappie are targeted as species indicative of the overall fish population health due to their high position in the food chain. Forage samples are conducted in conjunction with fall electrofishing samples. Although gill nets were used to sample the fish population in the past, beginning in 2006, they were used to sample larger-bodied fish (i.e., > 5 lbs.) and commercial species of fish (e.g., catfish, common carp, and freshwater drum). Lead net sampling began in 2011 to target crappie.

Largemouth bass

Biomass estimates-

Largemouth bass are targeted for evaluation since they are a species indicative of the overall fish population due to their high position in the food chain. Figure 1 indicates the standing crop estimates of largemouth bass in pounds per acre from 1973 to 1991. Data prior to 1973 was not available for analysis. Sample sites for Caddo Lake were typically in open water areas and may not reflect quality bass habitat. The average standing crop of bass on Caddo Lake for this time period is 4.48 pounds per acre.

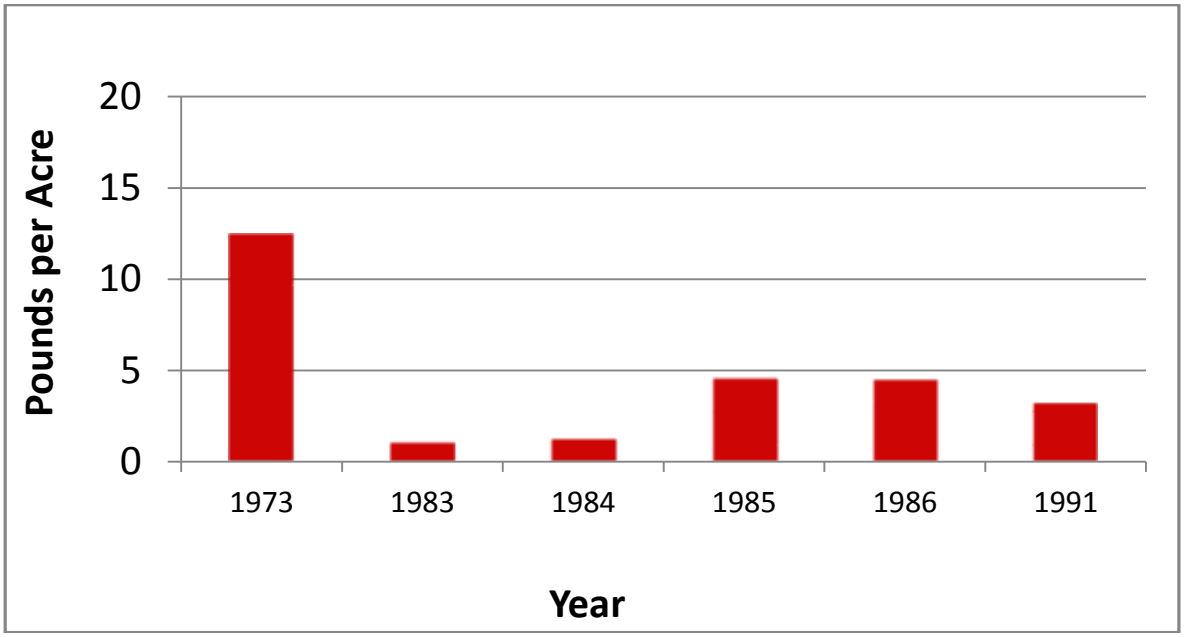


Figure 1. Annual estimates in pounds per acre of largemouth bass collected from biomass (rotenone) sampling results in Caddo Lake, LA from 1973 to 1991.

Catch Per Unit Effort and Size Distribution-

Catch per unit effort (CPUE) is the term used to describe the number of fish collected during a given time period of sampling. For electrofishing samples, the standard CPUE time period is one hour and the unit is number of fish captured. Catch per unit effort is an index of relative abundance for electrofishing and is usually displayed as the number of fish captured per hour of sampling effort.

Electrofishing has been the primary sampling technique utilized on Caddo Lake in recent years. Results from spring electrofishing samples for stock-size (i.e., total length ≥ 8 in.) largemouth bass from 1991 – 2013 are presented in Figure 2. The trend line indicates variation between years.

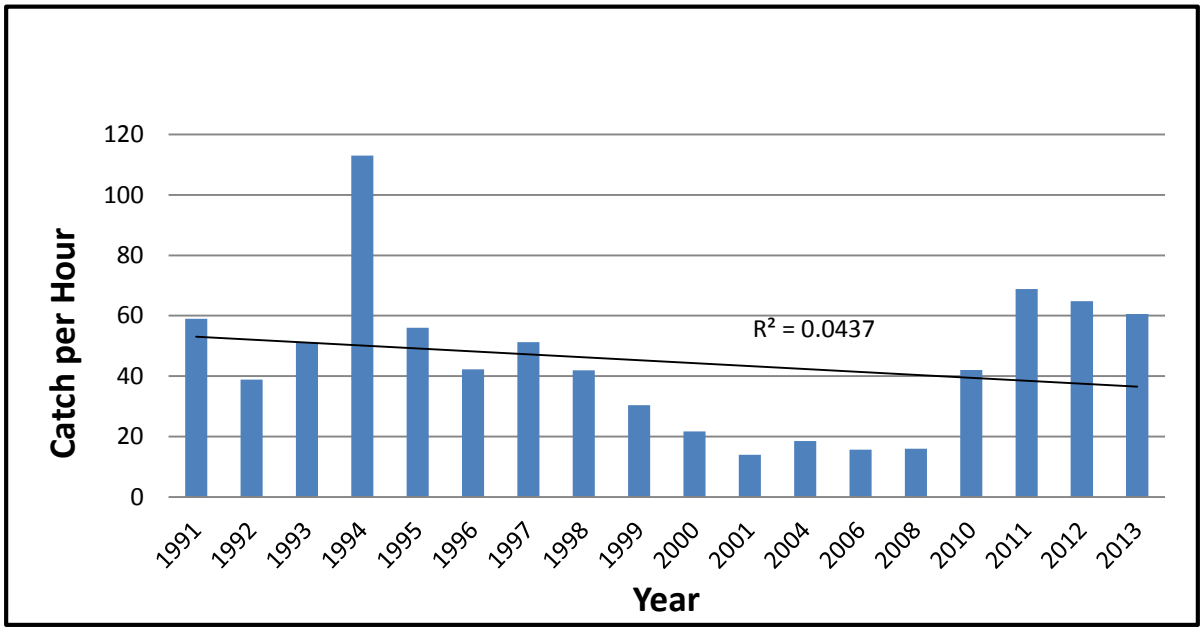


Figure 2. Spring electrofishing catch-per-unit-of-effort (CPUE) for stock-size (8" and larger) largemouth bass on Caddo Lake, LA from 1991-2013.

The CPUE for stock-size largemouth bass from the fall electrofishing samples are shown in Figure 3. The trend line for the data shows no significant change in the CPUE of stock size bass over the time period sampled.

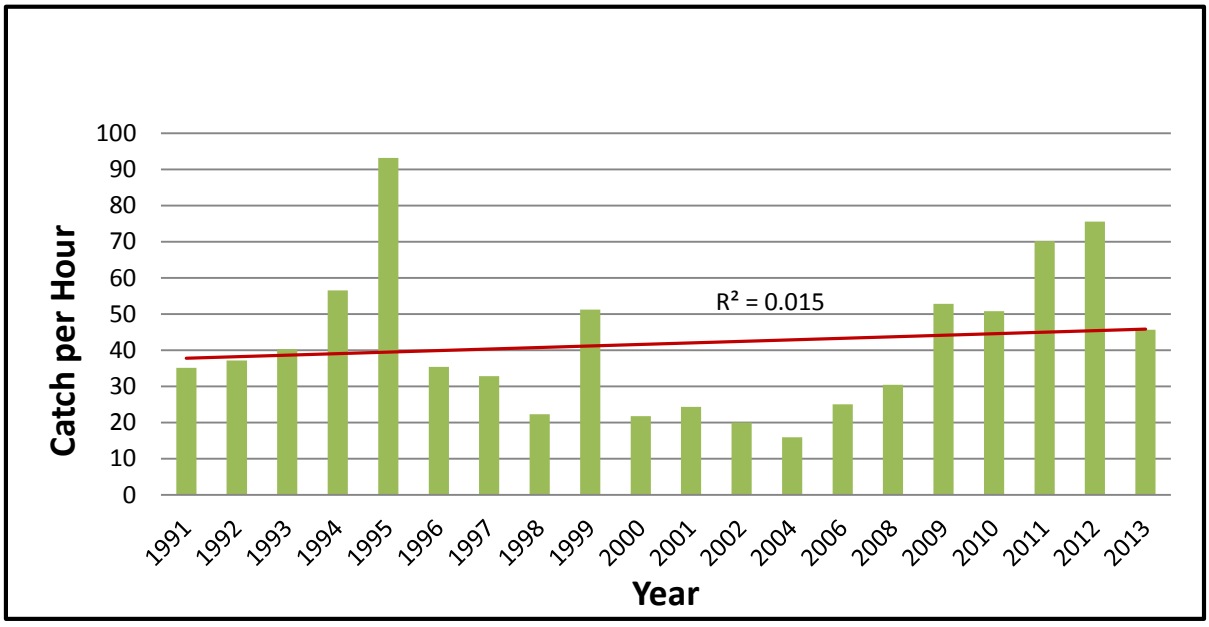


Figure 3. Catch-per-unit-of-effort (CPUE) for stock-size (8" and larger) largemouth bass collected during fall electrofishing sampling on Caddo Lake, LA from 1991-2013.

Proportional stock density (PSD) and relative stock density (RSD) are indices used to numerically describe size-distribution (length) data. Proportional stock density compares the

number of fish of quality-size (greater than 12 inches for largemouth bass) to the number of bass of stock-size [greater than 8 inches in total length (TL)]. The PSD is expressed as a percentage. A fish population with a high PSD consists of a greater number of larger individuals, whereas a population with a low PSD consists of fewer large fish. Relative stock density compares the number of fish of a given size range to the number of bass of stock size. A common calculation used in fisheries management is for RSD-Preferred (RSD-P). This value compares the number of largemouth bass > 15 inches TL to the number of stock-size largemouth bass in the population. This is also commonly called RSD-15 values. Values for PSD and RSD – Preferred (> 15 inches in TL) from the spring electrofishing samples are shown in Figure 4. Ideal PSD and RSD-P values for largemouth bass range from 40-70 and 10-40, respectively. Spring electrofishing samples from recent years indicate that the Caddo Lake largemouth bass population is near the upper end of the preferred range for both statistics, thus Caddo Lake has an abundance of fish in desirable size ranges (Figures 4 and 5). Trend lines suggest a slight increase in PSD and RSD-P values for largemouth bass in Caddo Lake over the period 1991 to 2013.

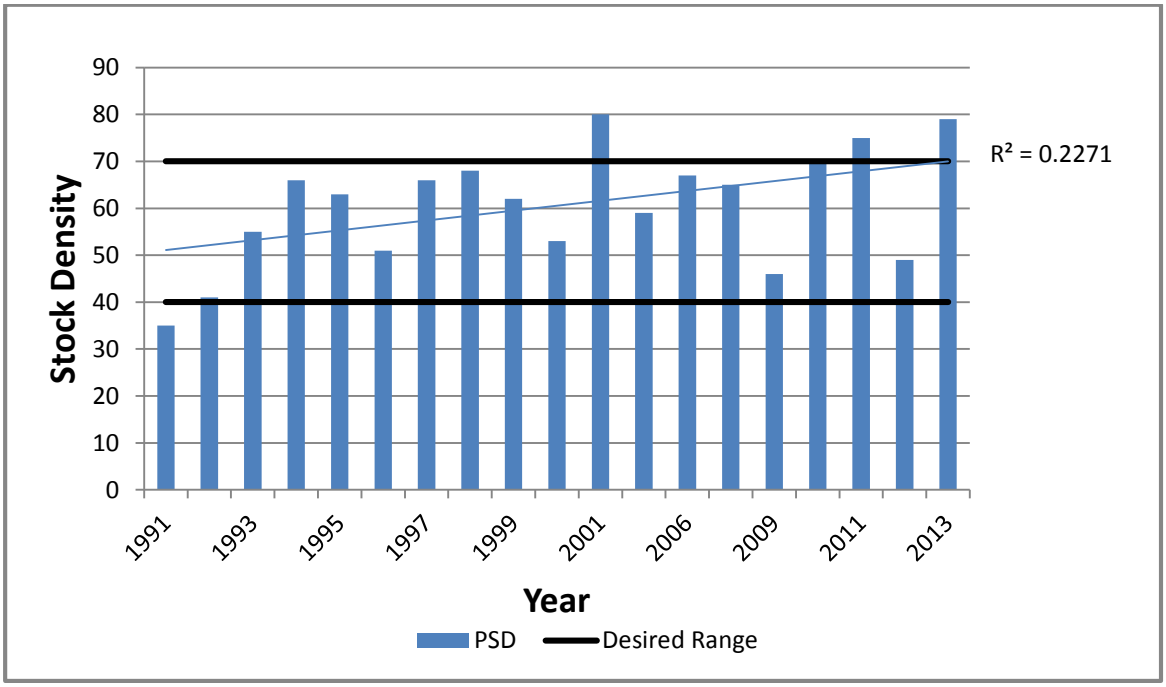


Figure 4. Proportional stock density for largemouth bass on Caddo Lake, LA, from 1991 to 2013 for spring electrofishing samples. R^2 values are for the trend lines shown.

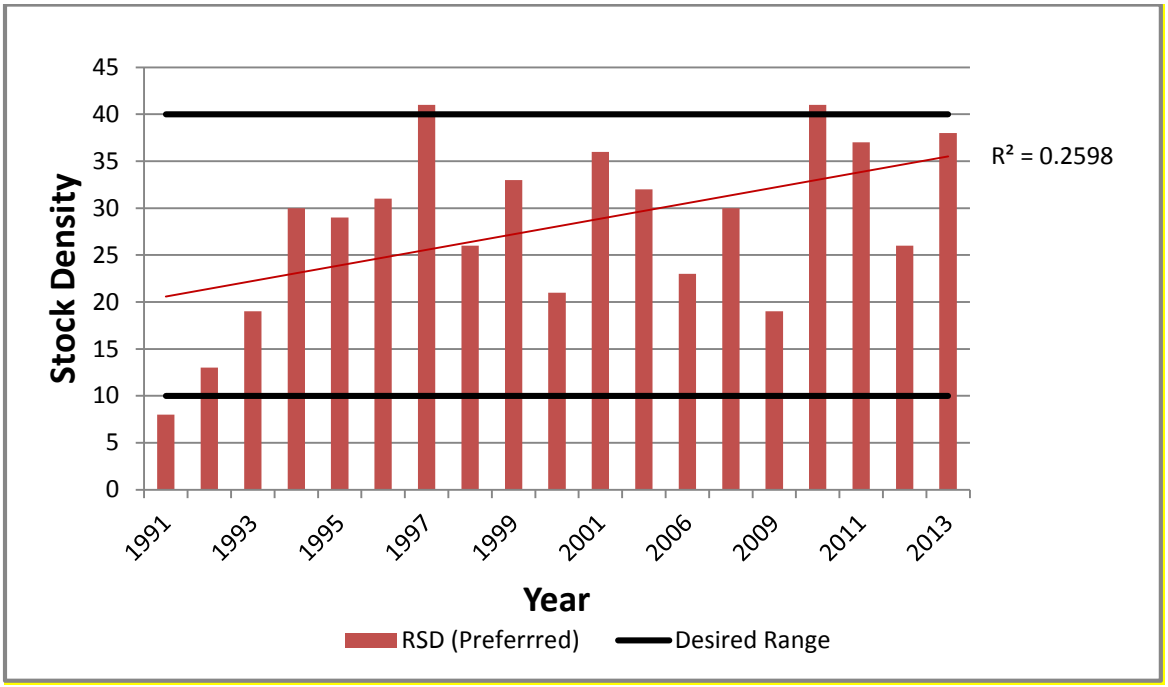


Figure 5. Relative stock density (preferred) for largemouth bass on Caddo Lake, LA, from 1991 to 2013 for spring electrofishing samples. R^2 values are for the trend lines shown.

The largemouth bass size-structure indices for fish collected during the fall electrofishing samples indicate results similar to those found in the spring samples with an increase in both PSD and RSD-P values during this time period (Figures 6 and7).

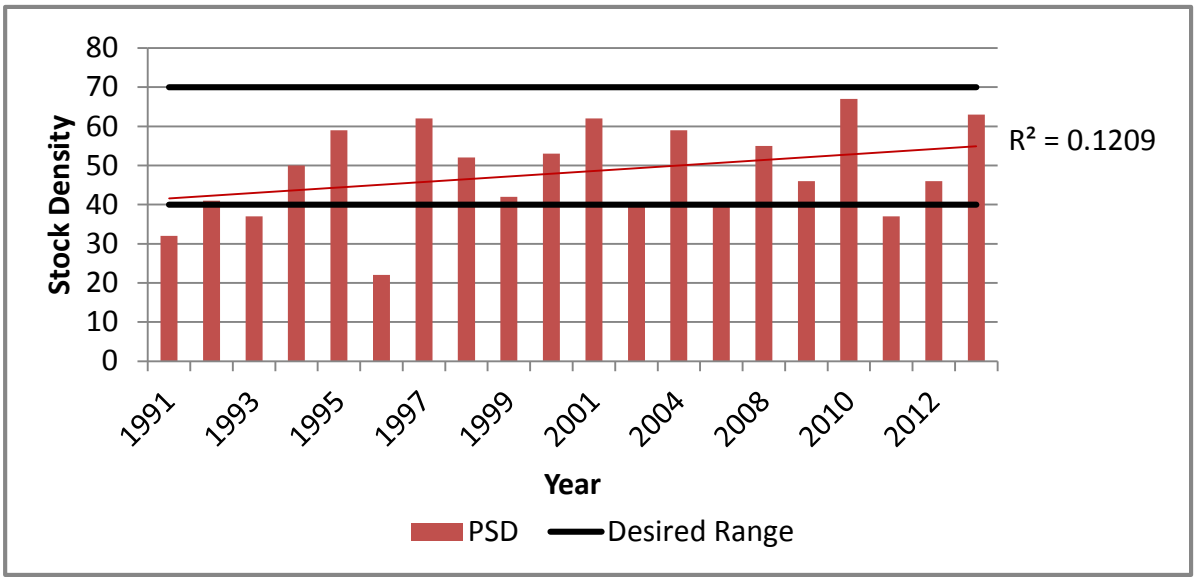


Figure 6. Proportional stock density for largemouth bass collected during fall electrofishing samples on Caddo Lake, LA from 1991 to 2013. R^2 values are for the trend lines shown.

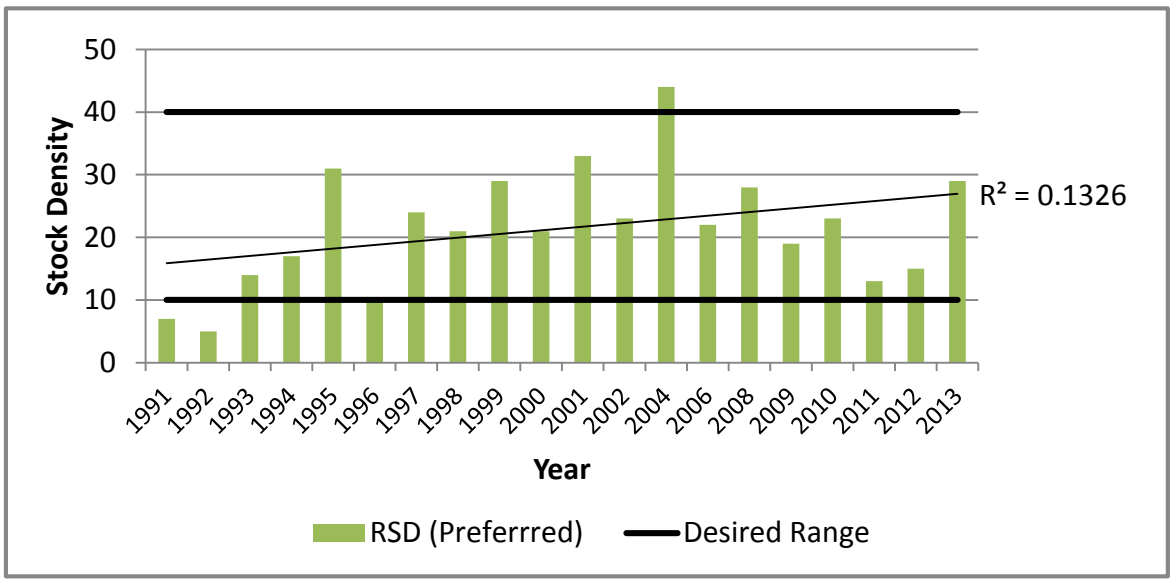


Figure 7. Relative stock density (preferred) for largemouth bass collected during fall electrofishing samples on Caddo Lake, LA, from 1991 to 2013. R^2 values are for the trend lines shown.

Size-structure indices data (Figures 4-7) indicate that the Caddo Lake bass population has changed over the past twenty years and now supports a population with a larger proportion of preferred-size ranges. Length distribution data from the most recent fall samples in 2013 shows an increased group of fish over 13-inches (Figure 8).

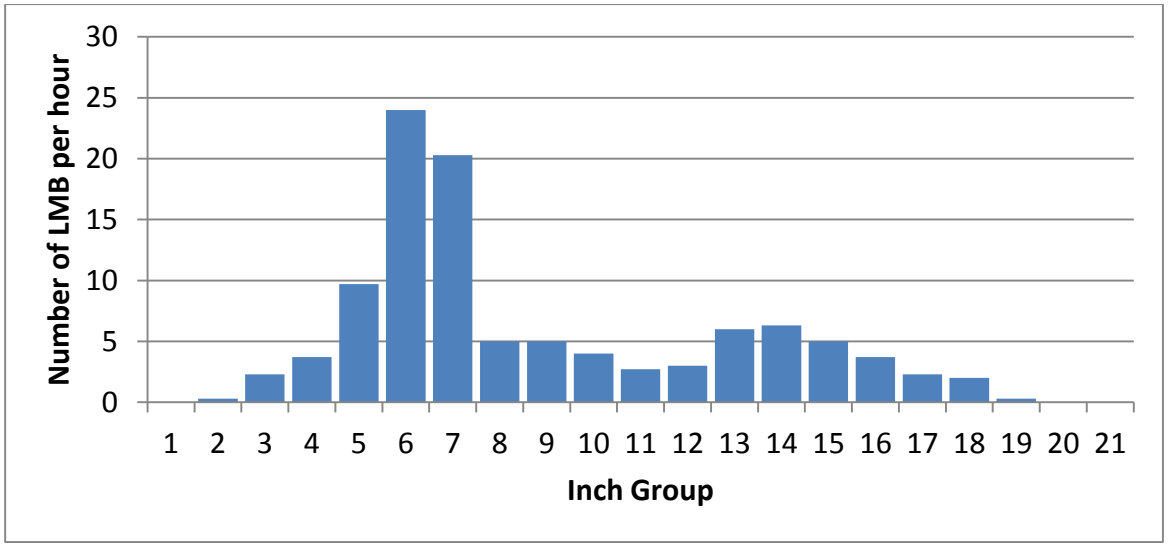


Figure 8. The length distribution (inch groups) of largemouth bass measured per hour of electrofishing effort on Caddo Lake, LA in the fall of 2013. N= 317.

Gill nets sampling is conducted to collect information related on fish that are not effectively sampled with standardized electrofishing techniques. Those fish include larger size bass, commercial species, and crappie. Gill net data from 2009-2013 are represented in Figure 9 and Figure 10. Largemouth bass up to 24 inches in total length were collected.

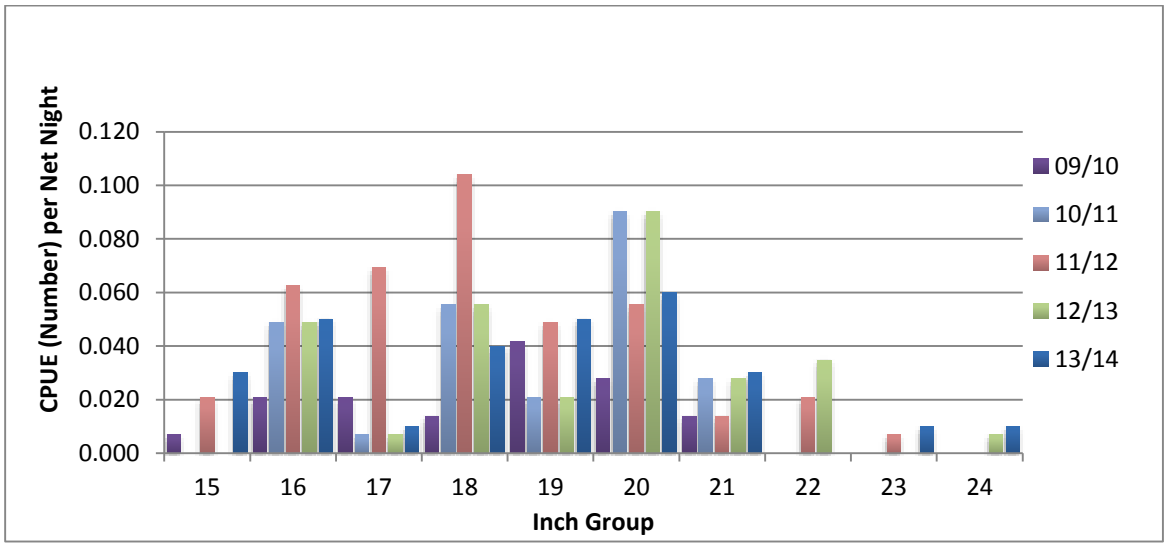


Figure 9. CPUE (number) per net night (100' net) of largemouth bass (*Micropterus salmoides*) collected during standardized gill net sampling on Caddo Lake, LA, 2009 - 2014.

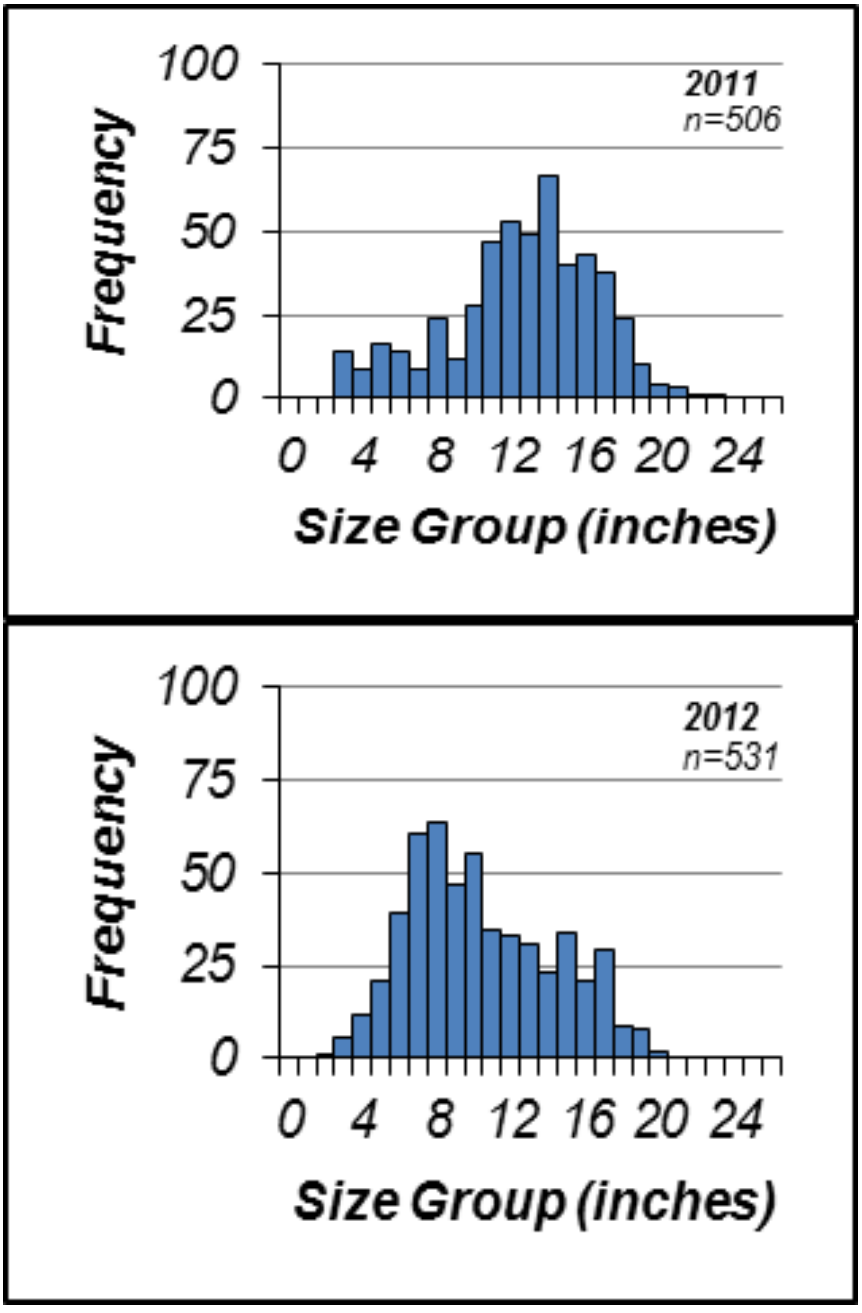
Figure 10. The mean CPUE (number) per net night (100' net) by inch group of largemouth bass (*Micropterus salmoides*) collected during standardized gill net sampling on Caddo Lake, LA, combined years 2009--2014.

Age, growth, and mortality

A study to describe the Caddo Lake largemouth bass population was completed in 2014 using data collected over the three-year period from 2011-2013. Population dynamics including relative abundance, recruitment, growth, body condition, mortality, and longevity were analyzed. Caddo Lake anglers were also surveyed to collect insight regarding their collective influence on the largemouth bass population.

Electrofishing gear was used to collect largemouth bass from Caddo Lake each spring. Length and weight measurements were recorded for each fish. Sagittal otoliths (ear bones) were removed from approximately 45% of the sampled fish for age and growth determination. Annual growth rings on the otoliths provide an accurate measurement of fish age. Size and age for all of the sample fish were combined to generate estimates of average growth rate and longevity. Angler surveys were conducted during the sample period to document fishing effort, angler catch rate and harvest rates.

As Figure 11 illustrates, Caddo Lake supports a healthy bass population. Largemouth bass ranging from 10 to 19 inches were well represented in the all three years of the project. It is important to note that spring sampling typically does not include fingerling size bass. However, the recurring presence of small (age-1) bass indicates consistently successful reproduction.


Frequency
100
75
50
25
0
2011
n=506
0 4 8 12 16 20 24
Size Group (inches)
Frequency
100
75
50
25
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2012
n=531
0 4 8 12 16 20 24
Size Group (inches)

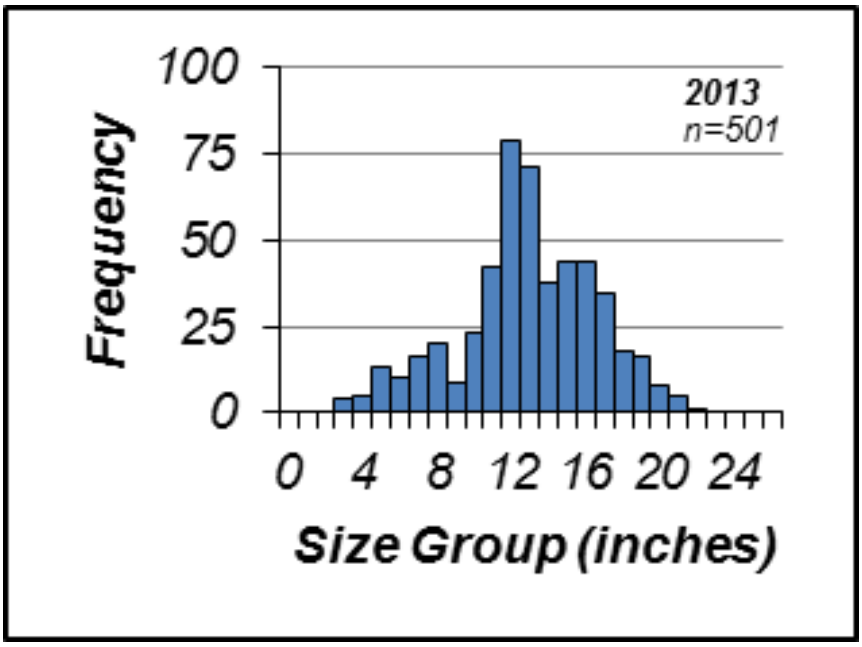

Figure 11. Annual length distributions of largemouth bass collected from Caddo Lake, LA during spring electrofishing surveys in 2011 – 2013.

Age structure of the complete electrofishing sample (2011-2013) is shown in Figure 12. Seventy-five percent of the total sample was comprised of age-1 through age-3 bass. The majority of the age 8+ fish were females. While bass up to 12 years old were found, only a small percentage (7.4%) of Caddo Lake largemouth bass were 6 years and older.

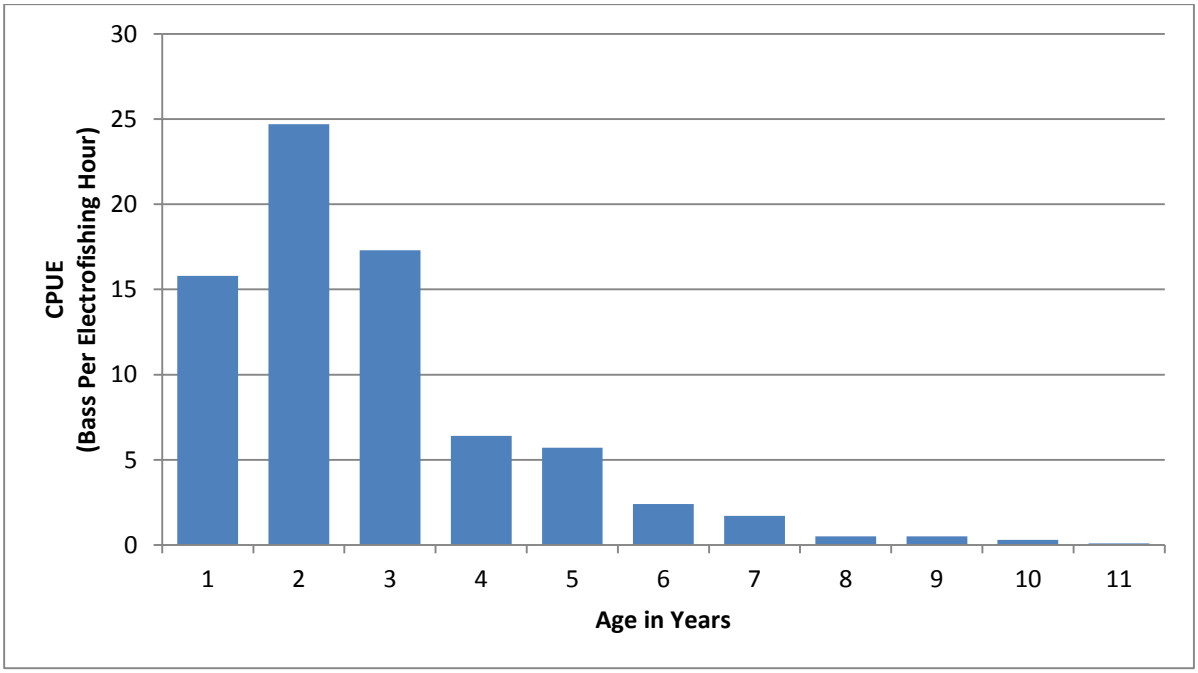

Figure 12. The catch per unit effort (CPUE) for largemouth bass by age class for Caddo Lake, LA, from spring electrofishing results, 2011 – 2013. *n* = 1,538.

Average length at age for Caddo Lake bass is provided in Table 1. Growth is rapid through age-5, but then slows to only an inch or less per year.

Table 1. Length at age for largemouth bass from Caddo Lake, LA, 2011 – 2013.

Age	Length in Inches
1.0	7.1
2.0	11.6
3.0	14.6
4.0	16.6
5.0	17.9
6.0	18.8
7.0	19.3
8.0	19.7
9.0	20.0
10.0	20.1
11.0	20.2

Body condition for Caddo Lake bass can be described as very robust. Good physical condition of bass generally is the product of an adequate food supply that is readily available to predation. Figure 13 shows the observed and predicted weight and total length from the 2011 – 2013 spring electrofishing samples.

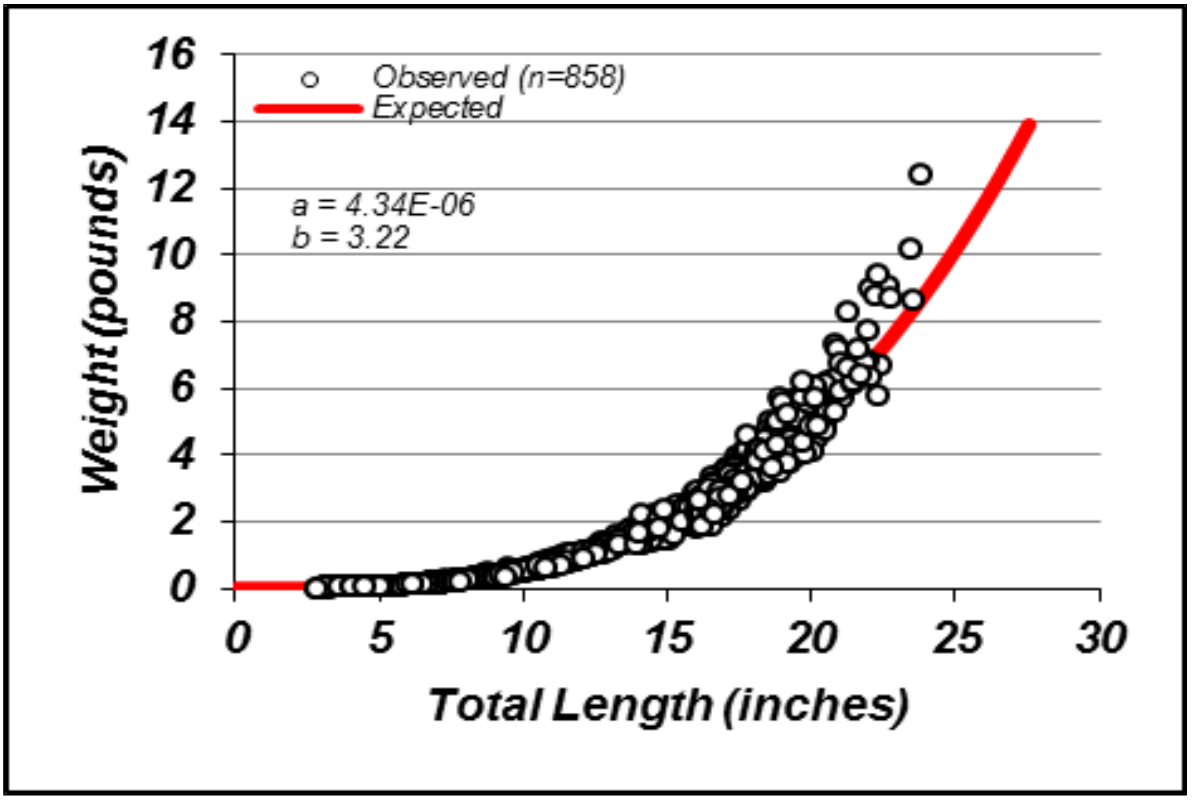

Figure 13. Observed and predicted weight at total length of Caddo Lake, LA, largemouth bass collected from spring electrofishing results 2011 – 2013.

Caddo Lake LMB recruitment can be considered moderately variable when compared to other Louisiana LMB populations previously studied. This recruitment variability of age-1 largemouth bass into the Caddo Lake population can be explained by changing factors

including water fluctuation, suitable forage, quality spawning substrate, and adequate protective cover for fingerlings.

The rate at which fish die each year is referred to as mortality. Mortality consists of two parts: natural mortality (predation, disease, senescence) and fishing mortality (angler harvest and discard mortality). Results of the study indicate that the total mortality rate for Caddo Lake bass is comparable to other recently sampled Louisiana lakes at 45% per year. The following example is provided to illustrate the effect. At 45% mortality, if you start with 100 age-1 Caddo Lake bass, only 9 will remain alive by age 5.

Length distribution, age structure, growth rate, and mortality rate were found to be at levels that provide a stable bass population in Caddo Lake. The results of this study suggest that the Caddo Lake bass population has a total mortality that is more influenced by natural mortality than fishing related mortalities (estimated 27 and 18%, respectively). The fishing mortality rate for Caddo Lake bass was estimated at 18% per year. This rate comes from two sources; 1) harvest and 2) post release mortality. Creel survey results indicate that only 32% of the anglers utilizing Caddo Lake describe themselves as bass anglers. The results also suggest that these same bass anglers voluntarily release a much larger percentage of largemouth bass than they harvest (83% of legal size fish are released). Bass anglers caught an average of 2.89 bass/trip during an estimated 5,291 bass angling trips annually. This creel information suggests that the 18% angling mortality estimate figure may be higher than what is actually occurring.

The current black bass regulation was implemented to use angler harvest as a management tool to increase abundance of bass larger than 18". Angler harvest is critical for effectiveness of the regulation, but the results of this project indicate that Caddo Lake largemouth bass harvest is lacking due to anglers' tendency to voluntarily release fish of legal harvest size. If Caddo Lake anglers remain hesitant to harvest bass, the effectiveness of any size regulation as a management tool is severely limited.

The results of this study were shared with Texas Parks and Wildlife Department (TPWD). LDWF's recommendation was to remove the protected slot limit, but TPWD had some reservations as they had some empirical data that indicated the slot limit may be effective. It was determined that maintaining unified regulations across the lake was of greater importance than changing the current black bass regulations. TPWD did express interest in seeing results of a similar study on largemouth bass performed on nearby Cross Lake. On Cross Lake, the protected slot limit was removed as the result of a three–year population assessment which found that the regulation was in-effective in producing larger-sized bass. The results of the Cross Lake assessment study will be shared with TPWD.

Largemouth bass genetics

Florida largemouth bass stockings on Caddo Lake were initiated in 1981 by Texas Parks and Wildlife Department and by LDWF in 1982 in an effort to offer anglers a chance to catch a fish of greater size. To date, both agencies combined have stocked over 12.3 million Florida largemouth bass fingerlings in Caddo Lake. Genetic analysis of the largemouth bass population in Caddo Lake has been conducted numerous times from 1991-2013. The results are listed in Table 2, the overall Florida genome ranged from 0% to 40.5% during the study period; however, the percentage of pure Florida largemouth bass remained low and ranged from 0% to 12%. Genetic testing form 2011-2013 included much larger sample sizes. Using

data from these three years, Caddo Lake bass population has an average of 31.6% Florida bass genetic introgression, but only 5% are pure Florida bass.

Table 2. Genetic Analysis of Largemouth Bass from Caddo Lake, LA from 1991 – 2013.

Year	Number	Northern	Florida	Hybrid	Florida Influence (%)
1991	34	34	0	0	0.0
1993	41	32	2	7	21.9
1995	30	19	2	9	36.7
1996	30	25	2	3	16.7
1997	59	40	2	17	32.2
1999	74	44	9	21	40.5
2002	43	37	0	6	13.9
2008	70	49	3	18	30.0
2009	72	55	1	16	23.6
2010	113	87	6	20	23.0
2011	272	189	20	63	30.5
2012	207	148	4	55	28.6
2013	269	173	16	80	35.7

Forage

Bass forage is measured directly through fall forage electrofishing results and indirectly through measurement of largemouth bass body condition or relative weight (Wr). Relative weight is the ratio of a fish's weight to the weight of a ''standard'' fish of the same length. The Wr index is calculated by dividing the weight of a fish by the standard weight for its length, and multiplying the quotient by 100. Largemouth bass Wr below 80 indicate a potential problem with forage availability.

Figure 14 illustrates the relative weight (Wr) for stock-size and larger fish collected during fall electrofishing samples from 1991 – 2013. Relative weights were generally above 90, indicating that abundant forage was available for these size groups of largemouth bass during the time period.

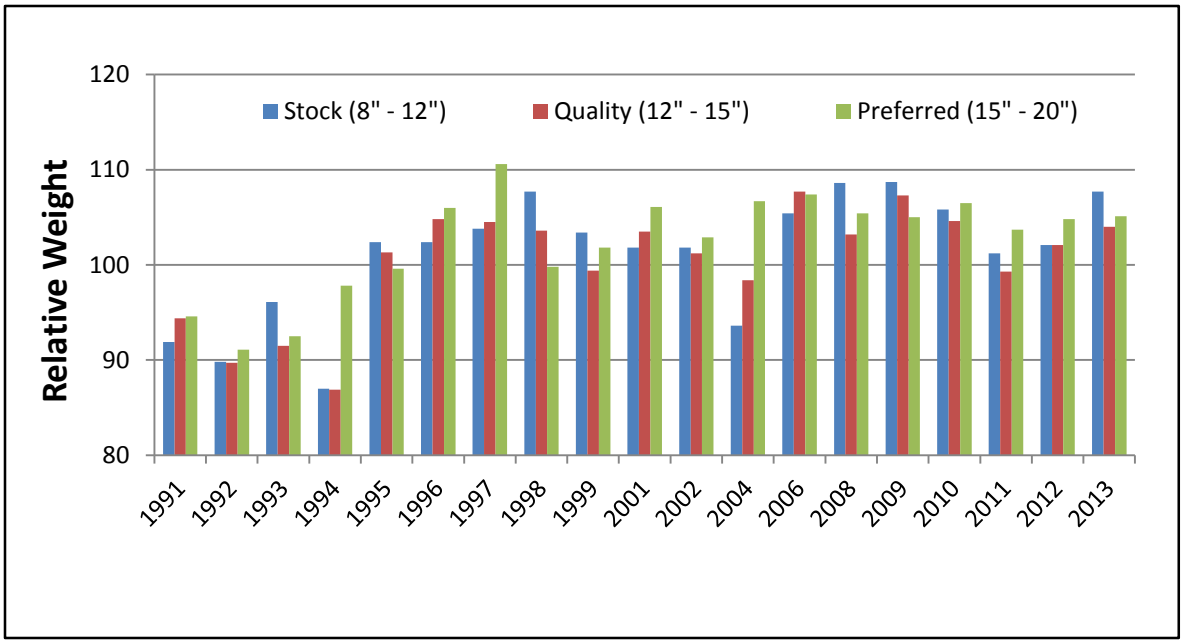

Figure 14. Relative weights of largemouth bass by size group collected during fall electrofishing from Caddo Lake, LA, from 1991 to 2013.

Forage fish are those that are available for use as food by predatory fishes. In general, all individuals up to six inches' total length are considered forage fish, particularly when discussing prey items for largemouth bass. Forage samples are collected in conjunction with fall standardized electrofishing samples. Standard procedures for collecting these samples were changed in 2012 in an attempt to get a more representative sample of the entire lake. Prior to this time, samples were only collected at one location each year. Shorter duration samples are now collected at four separate locations each fall. Forage samples collected in the fall of 2013 resulted in a mean catch rate of 32.03 pounds per hour of forage fishes, with *Lepomis* spp. (sunfish) accounting for the majority of the available forage. Figure 15 shows the mean number per hour of forage fish species collected for Caddo Lake in 2013.

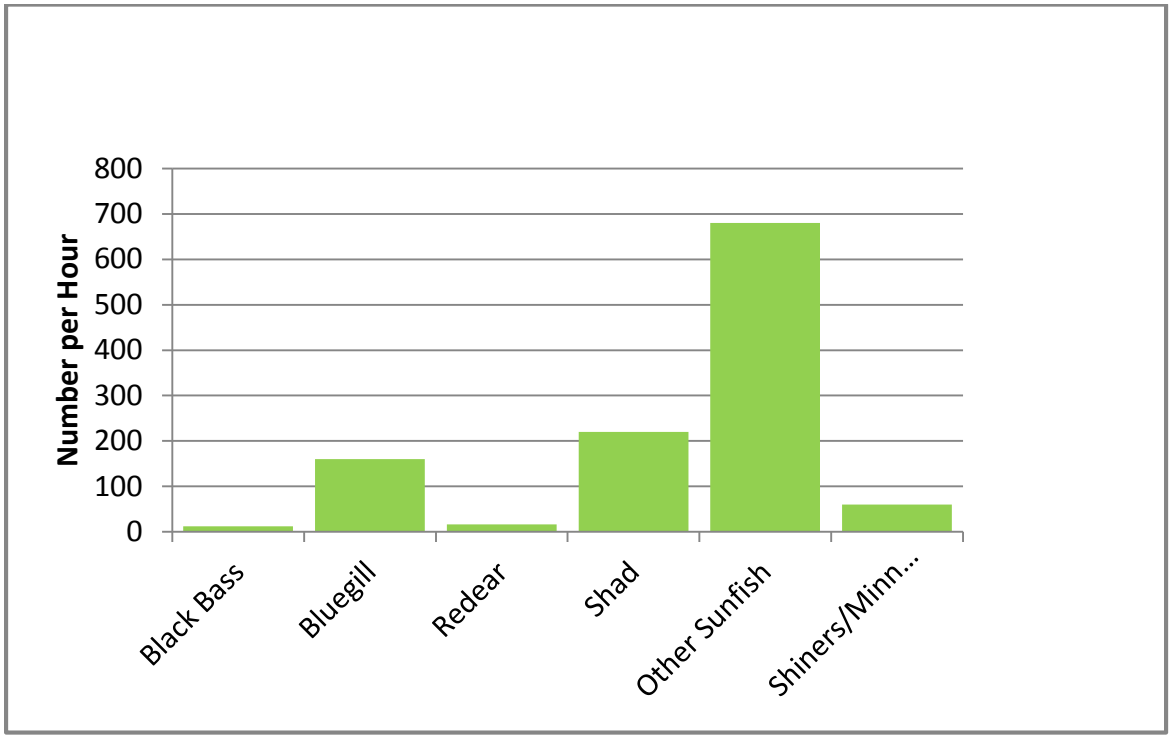

Figure 15. The CPUE in number per hour of fishes ≤ 6 inches TL from forage samples captured in Caddo Lake, LA in 2013.

Crappie

Until 2011, crappies were sampled on Caddo Lake with rotenone, electrofishing gear, or gill nets. Rotenone and electrofishing sampling yielded inconsistent, small sample sizes. Gill nets were used to collect larger size crappie, but the gear did not collect smaller size crappie and therefore could not be relied upon for size distribution data. In 2011, LDWF began sampling crappie specifically with lead nets. Catch rates and sampling confidence increased.

Crappie collected during biomass (rotenone) sampling conducted from 1954 to 1991 consisted of both black crappie (*Pomoxis nigromaculatus*) and the more abundant white crappie (*Pomoxis annularis*). The Caddo Lake biomass samples averaged a relatively low 0.739 pounds per acre per year from 1973-1991(Figure 16). Data prior to 1973 was not available for this analysis.

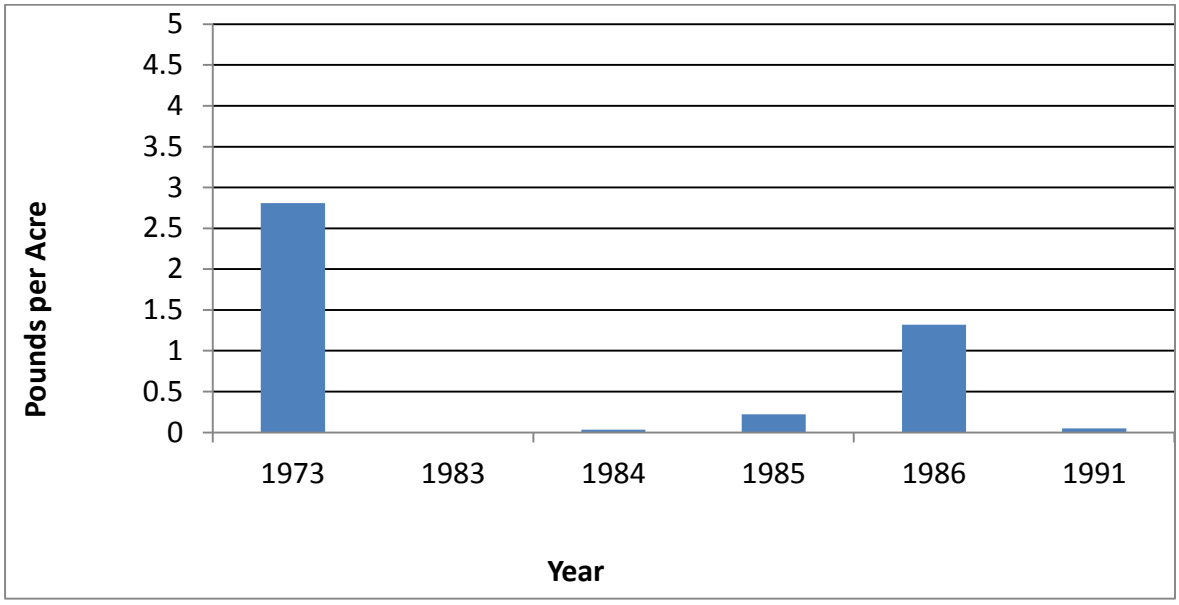

Figure 16. The CPUE in pounds per acre of crappie collected from Caddo Lake, LA, during biomass (rotenone) sampling from 1973 to 1991.

Few crappies were collected during spring electrofishing samples from 1991 – 2013 as depicted in Figure 17. Overall numbers were low in most of the samples and no crappies were collected in several of the samples. The CPUE was generally higher in the 2011-13 samples, but this can be explained by a shift in sampling strategy. Samples were collected earlier in the spring than previous years, when more crappies were utilizing shallow shorelines for spawning. This sampling was part of a three-year mortality study for largemouth bass.

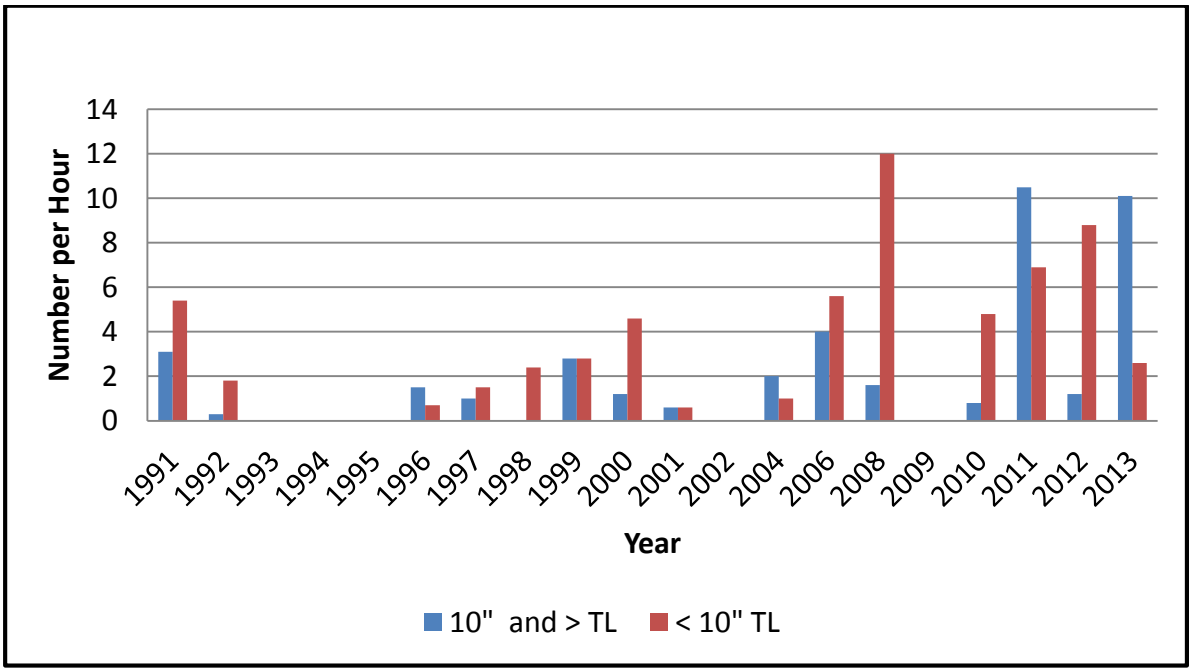

Figure 17. The CPUE of crappie captured during springtime electrofishing samples from Caddo Lake, LA from 1991 to 2013.

Results from gill net sampling are indicated in Figure 18. Sampling reveals a viable population of larger size crappie in Caddo Lake. Crappies in excess of two pounds are common from gill net samples. A few individual fish over three pounds have been collected.

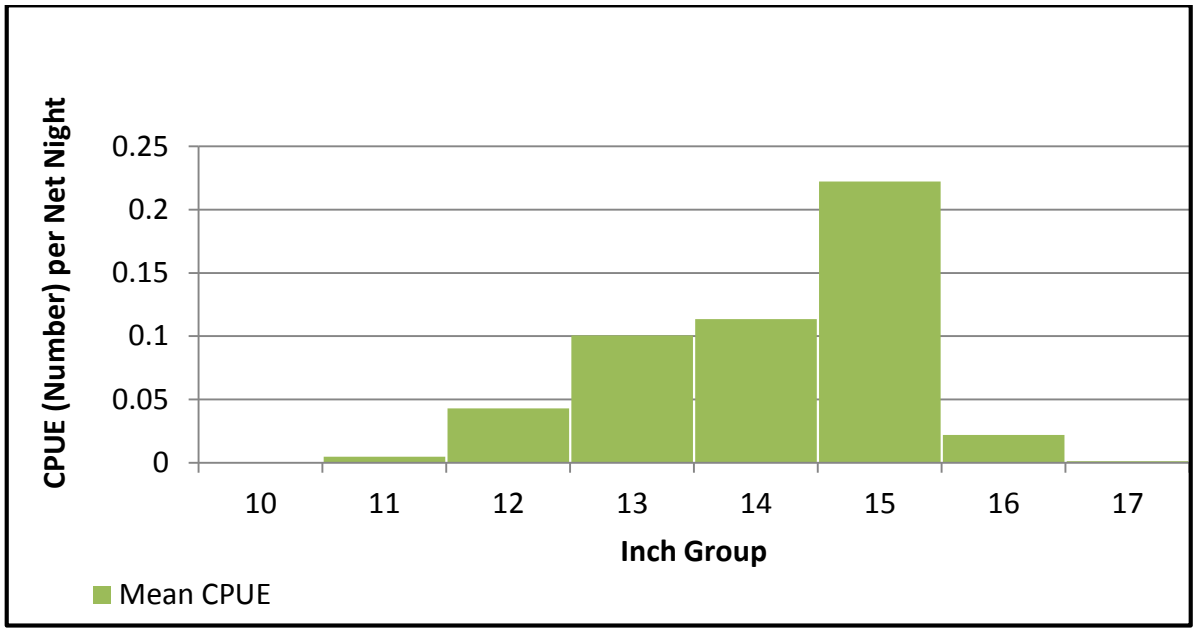

Figure 18. The Mean CPUE (number) per net night (per 100' net) of crappie collected during standardized gill net sampling on Caddo Lake, LA, from 2006 - 2014.

Lead net sampling was conducted in Caddo Lake from 2011 – 2013 in conjunction with a crappie population assessment study. Sagittal otoliths were also collected as part of the study. Analysis of the data is presented below in the Crappie Population Assessment Study section of this report.

The length frequency comparisons by year, for crappie taken with lead nets show some variation from year to year. The majority of the crappie collected from Caddo Lake with lead nets range from 5 inches to 10 inches, with the most commonly captured group being seven inch. However, a large portion of crappies collected were greater than 12 inches. These results compliment the results of gill net sampling and indicate that Caddo Lake supports memorable and trophy size crappie. The CPUE values for each size group are provided in Figure 19.

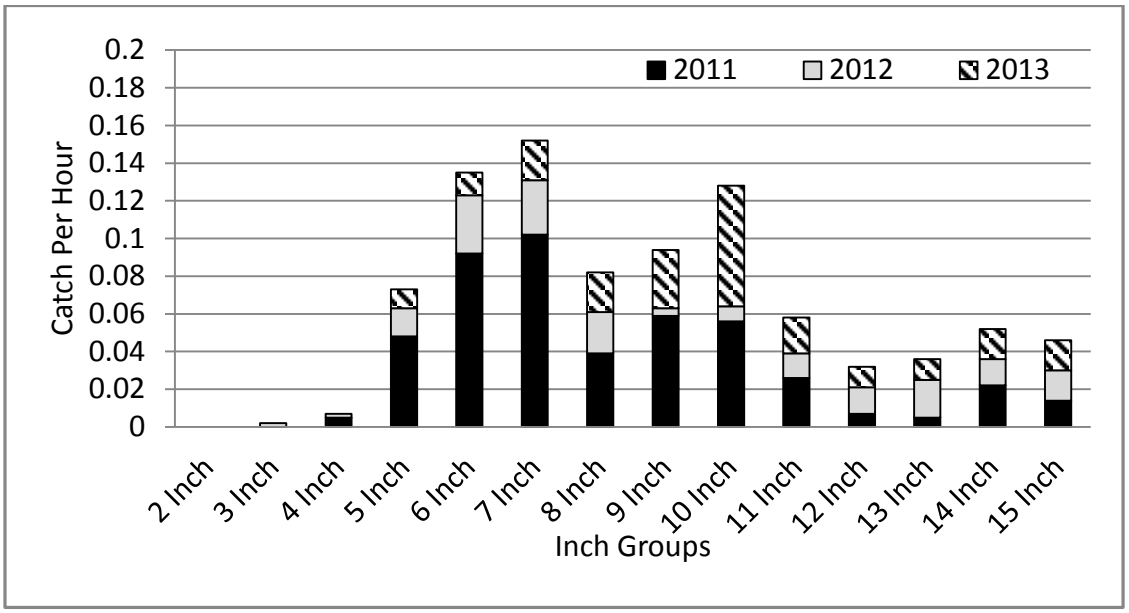

Figure 19. The CPUE (catch per hour) by inch group for crappies collected on Caddo Lake, LA from lead net sampling during 2011 – 2013.

Figure 20 depicts the catch per hour for crappies of selected size groups collected in lead net sampling. Catch rates of the memorable or larger size groups remained fairly consistent during the sample period. There was a decrease in stock size and a slight decrease in quality size groups over the same period. In general, catch rates in 2012 were much lower than the other two years. Very few black crappies were collected during 2012. Water levels were quite low during the 2012 samples. Anecdotal information from anglers suggested that most of the black crappie had migrated to deeper water areas.

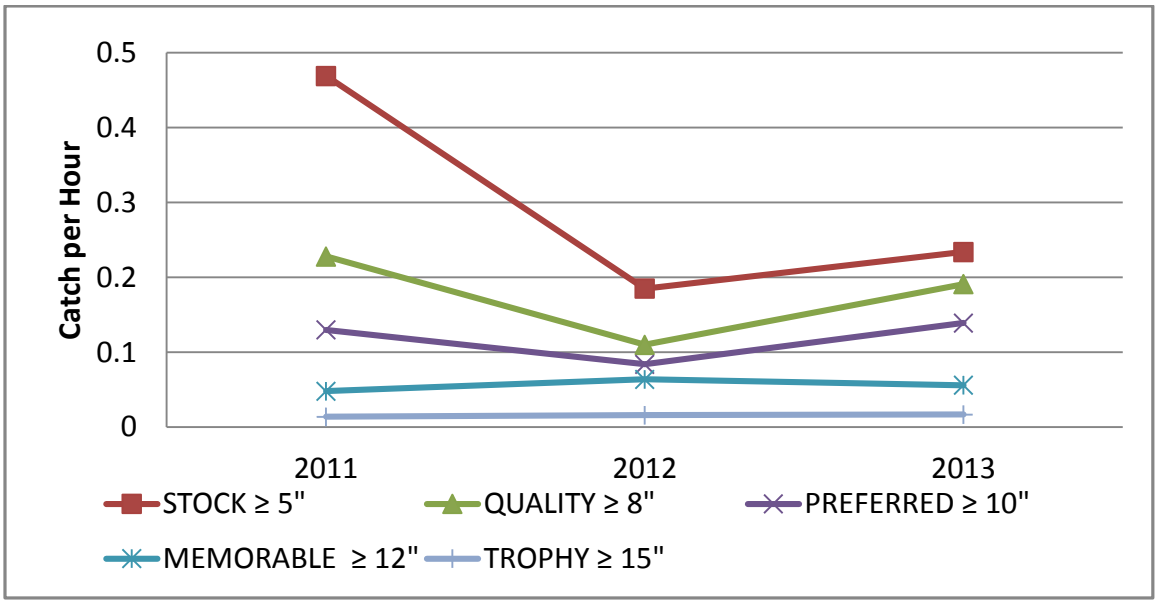

Figure 20. The CPUE (catch per hour) of selected crappie size groups caught in Caddo Lake, LA, by lead net sampling 2011 – 2013.

Relative stock density (RSD) and proportional stock density (PSD) values for crappies are

also derived from lead net sampling results. These stock density indices are illustrated in Figure 21. The indices reveal an increase in the proportion of fish greater than 8 inches, collected in lead net samples over the period 2011 – 2013. Sampling shows that the large group of stock-size crappie collected in 2011 grew and moved into the larger size groups.

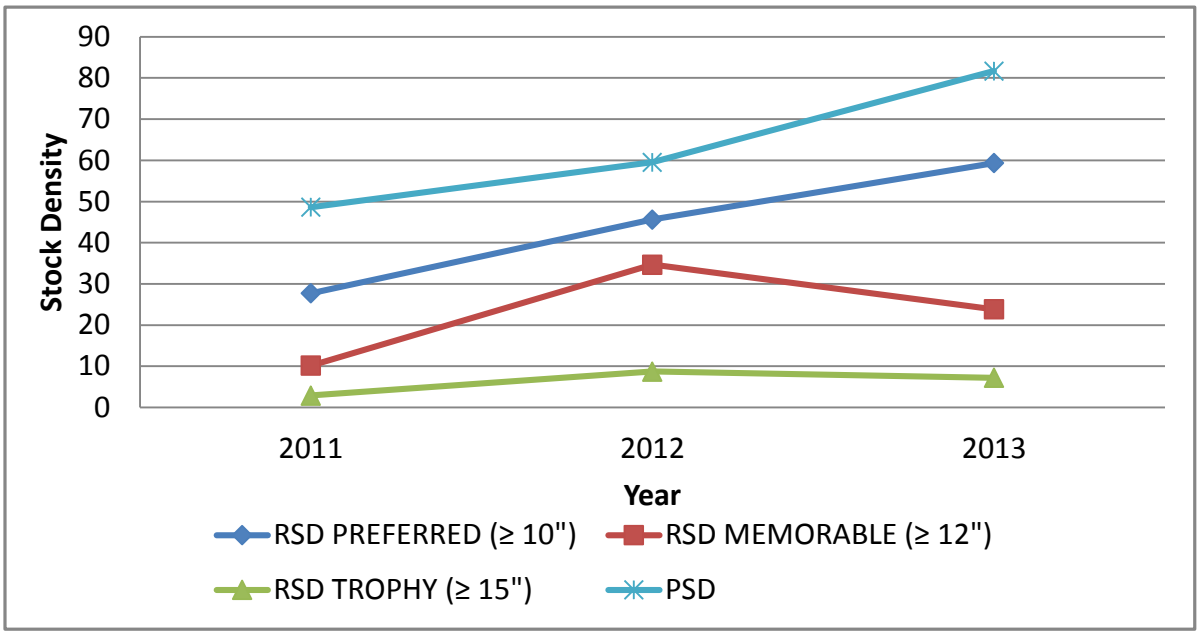

Figure 21. Stock density indices for crappies caught in Caddo Lake, LA, by lead net sampling 2011 – 2013.

Crappie Population Assessment Study:
An assessment study to describe the Caddo Lake crappie population was completed in 2014. The project included data collection over a three-year period from 2011-2013. Population dynamics including relative abundance, spawning success, growth, body condition, mortality, and longevity were analyzed. Caddo Lake anglers were also surveyed to collect insight regarding their collective influence on the crappie population.

Lead nets were used to collect crappie from Caddo Lake each fall. Length and weight measurements were recorded for each fish. Sagittal otoliths (ear bones) were removed from approximately 47% of the sampled fish for age and growth determination. Annual growth rings on the otoliths provide an accurate measurement of fish age. Size and age for all of the sample fish were combined to generate estimates of average growth rate and longevity. Angler surveys were conducted during the sample period to document fishing effort, angler catch rate and harvest rates.

The Caddo Lake crappie population is comprised of both white crappie (63%) and black crappie (37%). Crappie tend to migrate within the lake and tend to stay in schools of mostly one species or the other. Sampling bias may have over-represented white crappie in the study. Caddo Lake crappie can be generally categorized as having fast growth rates. Relative stock density indices that fall within or slightly above the desired ranges (RSD-Q=65, RSD-P=47), and Caddo Lake had the highest RSD for memorable (>12" TL) crappie throughout the state (RSD-M=22). Caddo Lake

crappie also exhibited excellent relative weights (102.3%) and the lowest total mortality rate (38%) from the lakes sampled. However, recruitment variability was high and may indicate potential problems with spawning success.

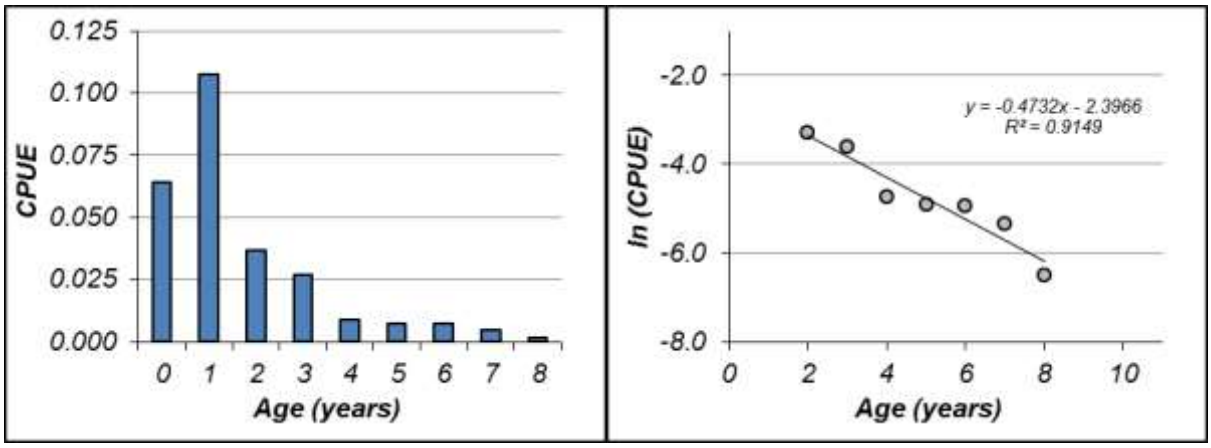

Figure 22: Observed mean catch rates by age of the Caddo Lake crappie fall lead net surveys (2011-2013; left graphic). Right graphic depicts observed (circles) and predicted (line) mean log_e CPUE by age. The catch curve equation and coefficient of determination (R^2) are presented in graphic. Catch per unit effort (CPUE) is defined as lead net catch per hour.

Although Caddo Lake crappie grow quickly, relatively few crappies survive past age 3. Of the 1,401 crappie collected during the study, only 10% of the fish collected were in the Age 4-8 range. Based upon the study, on average crappie will reach quality size (8-inches) in 1.23 years, preferred size (10-inches) in 1.77 years, and memorable size (12-inches) in 2.58 years. Based upon creel data collected in 2011, it appears anglers are having little impact upon the population.

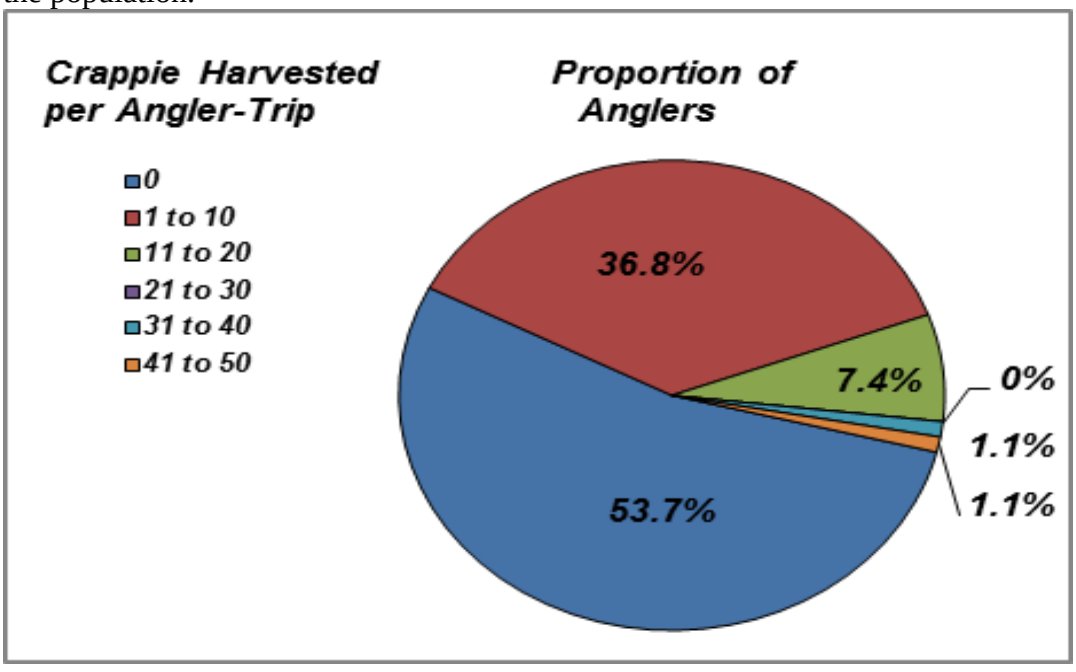

Figure 23: Frequencies of numbers of crappie harvested per angler-trip for Caddo Lake crappie anglers derived from the creel survey conducted in 2011.

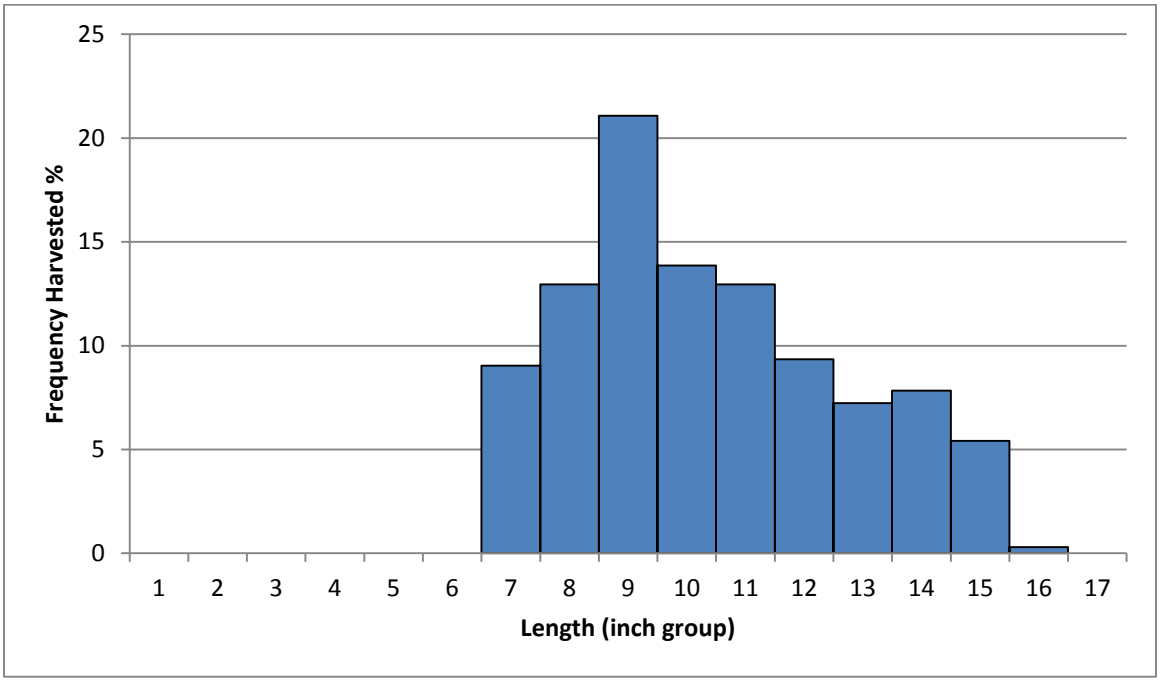

Figure 24: Size distribution of crappie harvested by inch group for Caddo Lake crappie anglers derived from the creel survey conducted in 2011.

The majority of trips resulted in no crappie harvested or less than 10 fish harvested (combined 90.5%) per angler. Of the fish harvested, one-third of the fish were less than 10-inches. It appears anglers have a self-imposed minimum length of approximately 7-8 inches before crappie are considered "big enough to keep." Caddo Lake crappie anglers averaged harvesting 3.5 crappie per trip, which is minimal impact given the growth rate and reproductive capacity of crappie in the lake.

Using this information, several simulated length regulations were modeled and the results predicted based upon the natural parameters of the Caddo Lake crappie population and the Caddo Lake crappie angler trends. The results would indicate that the current fishing pressure is far too low for any size regulation such as a 10-inch or 12-inch minimum length limit to impact the population. If such a regulation were to be implemented, it would mean crappie anglers would be forced to release a much larger percentage of their catch (35-60% more). Additionally, it was estimated that the total yield in pounds harvested and the number of fish harvested per trip would both decline under minimum length limits. Since most crappie anglers are interested in harvesting fish, such a release rate would not be acceptable.

Commercial

Caddo Lake supports healthy populations of catfish. Recreational catfish fishing accounted for 7.4% of the total angling effort during the 2011 creel survey. Commercial fishing for catfish is common on Caddo. The use of gill nets, trammels nets, and fish seines was prohibited in Caddo Lake on January 1, 1983 by the Louisiana Wildlife and Fisheries Commission. Most commercial fishing on the lake is conducted with small hoop nets, wire traps, or slat traps.

Biomass sampling

Historical biomass sampling on Caddo Lake indicates that channel catfish (*Ictalurus*

punctatus), and freshwater drum (*Aplodinotus grunniens*) were present in significant numbers in the lake (Figure 25).

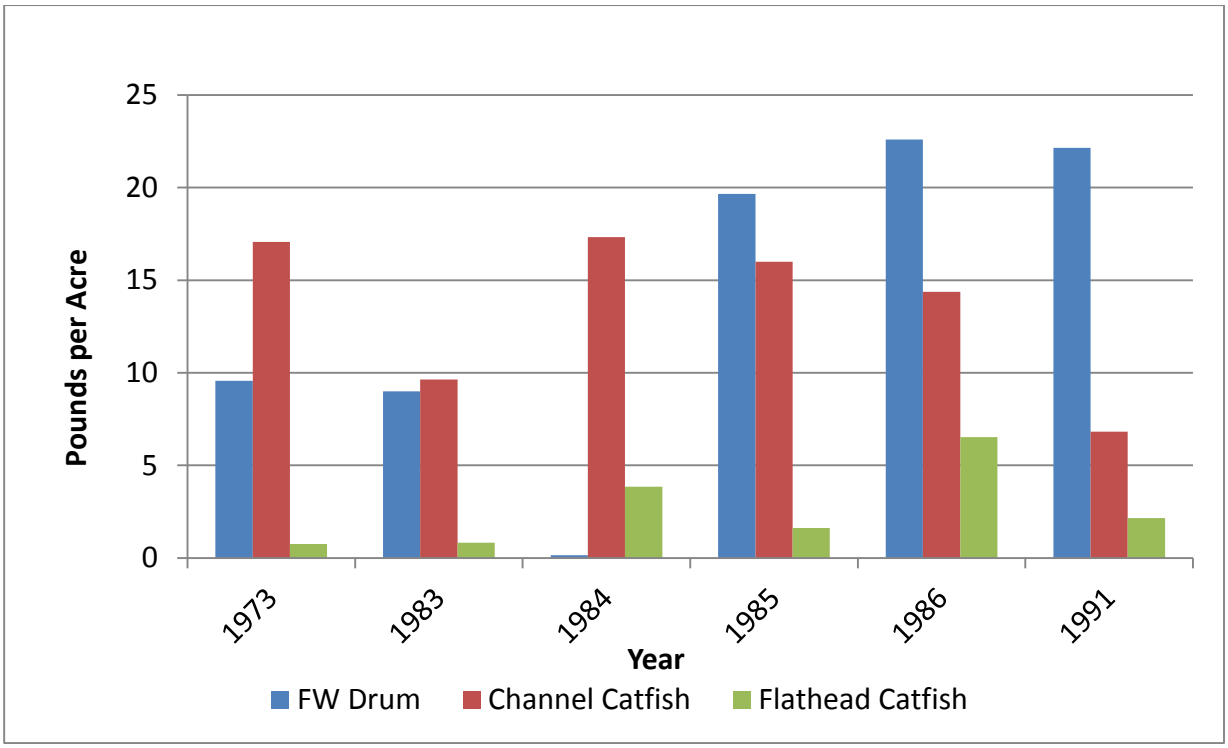

Figure 25. The CPUE in pounds per acre of commercial fish collected during standardized biomass (rotenone) sampling in Caddo Lake, LA, from 1973 to 1991.

Gill nets

Standardized sampling with gill nets was conducted on the lake from 2006 – 2013. The primary commercial species collected were catfish and carp as indicated in Figure 26.

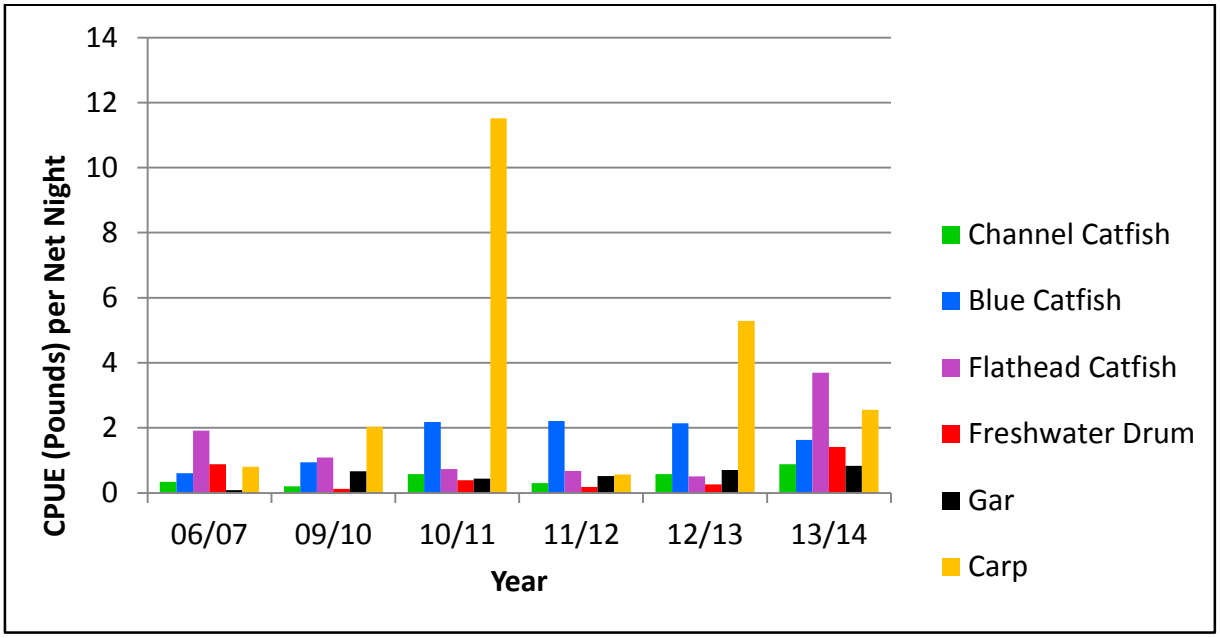

Figure 26. The CPUE in pounds per net night (100' net) per year for commercial species in Caddo Lake, LA collected with standardized gill nets from 2006 – 2014.

HABITAT EVALUATION

Aquatic Vegetation

Portions of Caddo Lake are heavily forested with cypress trees and aquatic vegetation has been a problem since impoundment. Before impoundment, the natural water regime of the area included high water levels in the spring and low water levels in the late summer and fall. These fluctuations provided natural control of aquatic plants. The large expanses of nutrient rich, shallow water provide ideal habitats for several species of problematic aquatic vegetation. Dense mats of vegetation adversely affect fisheries habitats and navigation.

Giant salvinia *(Salvinia molesta)*, which is a free floating aquatic fern native to Brazil, was discovered on Caddo Lake in June 2006. Giant salvinia has the potential to double in biomass every 3-5 days. In Caddo Lake, salvinia coverage expands at a tremendous rate during the prime growing season. Heavily forested areas provide sheltered nursery areas where the salvinia grows prolifically. Due to restricted access, foliar herbicide applications are difficult in many of these areas.

Since 2006, giant salvinia coverage has expanded (up to 3,000 acres on the Louisiana side of the lake) and been reduced numerous times. Herbicide efforts combined with cold weather events and natural water fluctuations have led to salvinia reductions. An annual pattern has been observed on Caddo Lake. Plants grow and expand coverage during the growing season. As winter approaches, cold weather slows the growth of the plants. High water events associated with winter rainfall flush the plants from the protected, tree-covered areas of the lake, such as James Bayou and Big Green Brake, into the limnetic portion of the lake. Here salvinia is either pushed over the spillway or thrown onto the exposed shorelines by wind and wave action. As flood waters recede, many plants are left stranded on the shore to die. By

spring, giant salvinia is greatly reduced and primarily located in the shallow, protected areas. As the weather warms, these plants begin to grow and multiply, completing the annual cycle.

Following a mild winter, giant salvinia reached problematic levels on Caddo Lake by late summer of 2016. LDWF treated a total of 1,197 acres of giant salvinia in 2016. LDWF stocked 52,315 adult and larvae giant salvinia weevils in Caddo Lake in 2016. At the peak of the growing season, giant salvinia covered approximately 1,500-1,750 acres of Caddo Lake on the Louisiana side of the reservoir. The infestation in Texas was more severe, with an estimated coverage greater than 6,000 acres.

The salvinia infestation in Louisiana was again concentrated in James Bayou and along the state line in the Big Green Brake area. The American lotus infestation between the Mooringsport Bridge and the dam has been greatly reduced from recent years following a successful aerial herbicide application in 2015 followed by the March, 2016 record flood event.

LDWF experience clearly indicates that herbicide applications for control of giant salvinia must be supplemented with additional means of control. Foliar herbicide applications are recognized as a valuable component of an integrated management program. The combination of physical, chemical, and biological measures has resulted in improved control of giant salvinia on many lakes in Louisiana, but satisfactory control has not been achieved to date. LDWF will continue to actively pursue additional tools to add to the integrated management program. Critical evaluation of existing and all proposed control measures will continue as part of the LDWF effort to combat this exceptionally prolific invasive species.

Hydrilla (*Hydrilla verticillata*) is the most-problematic submerged aquatic plant in Caddo Lake. Hydrilla coverage varies greatly from year to year. The plant has covered nearly 2,000 acres of the Louisiana side of Caddo Lake on several occasions. During some years, it is almost non-existent. Annual densities of the plant are closely tied to water levels and springtime water turbidity.

Water hyacinth (*Eichhornia crassipes*) has historically caused problems, but the invasive has been replaced by giant salvinia in many areas. Hyacinths still cause significant problems in some Texas portions of Caddo Lake.

Artificial Structure

No artificial reefs have been placed in the lake by the Department of Wildlife and Fisheries. Man-made structures along the shoreline of the lake such as piers and boat houses do provide additional cover for fish. There are many duck blinds and oil derricks (both active and inactive) that provide cover for fishes in the limnetic zone of the lake.

Substrate

The bottom substrate in many areas of Caddo Lake is composed largely of organic detritus. Cypress leaf litter and aquatic vegetation are the major contributors to organic accretion. Prior to impoundment, low water levels in the late summer and fall allowed aerobic decomposition of organic material. With permanent impoundment, organic decomposition occurs through the much slower anaerobic process. As a result, organic substrate continues to accumulate and spawning substrate becomes more impaired.

CONDITION IMBALANCE / PROBLEM

Three major issues threaten Caddo Lake and hinder the successful management of the resources of the lake.

1. Habitat degradation has occurred from the accumulation of organic material. The accumulation of organic material has reduced quality nesting habitat and impaired sportfish production.
2. Invasive species, including giant salvinia, hydrilla, and water hyacinth currently are the greatest threat to habitat quality and navigation.
3. The loss of the natural water regime and the absence of a water control are inherent contributors to habitat impairment.

CORRECTIVE ACTION NEEDED

Improvements to the water control structure are needed to address an impaired natural hydrologic regime.

Additional control tools are needed to supplement the existing integrated management program for aquatic plants in Caddo Lake.

RECOMMENDATIONS

1. Continue an integrated management approach to control invasive aquatic vegetation.
   a. LDWF will combine aggressive herbicide applications and biological control measures to achieve combined benefits. Foliar herbicide applications will be conducted in accordance with the approved LDWF Aquatic Herbicide Application Procedures. The herbicide diquat (0.75 gal/acre) and a non-ionic surfactant (0.25 gal/acre) will be used for giant salvinia control from November 1 through March 31. Outside of that time frame, giant salvinia will be controlled with a mixture of glyphosate (0.75 gal/acre) and diquat (0.25 gal/acre) with Turbulence (0.25 gal/acre) surfactant.
   b. Salvinia weevil introductions will continue. Weevil survival and stocking success will be monitored. Weevils will be transported throughout the lake.

2. Continue scheduled standardized sampling of fish populations.
   a. Use data collected from 2010-2013 largemouth bass and crappie population assessment studies to evaluate the effectiveness of current regulations.
   b. Share the results of the studies with Texas Parks and Wildlife Department.

3. Continue Florida largemouth bass stockings.

4. Continue cooperative effort to develop the Caddo Lake Watershed Management Plan.

5. Collaborate with other agencies working to resolve the hydrology issues on Caddo Lake.